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Biology 30

Diploma Examination Results

Examiners' Report

January 1992

CANADIANA
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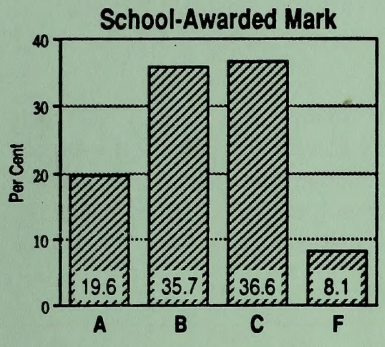

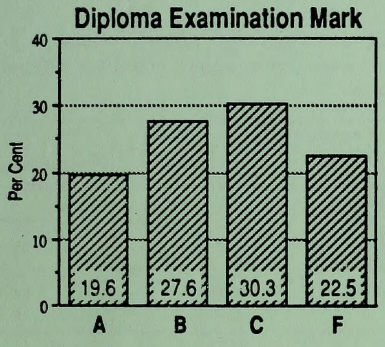

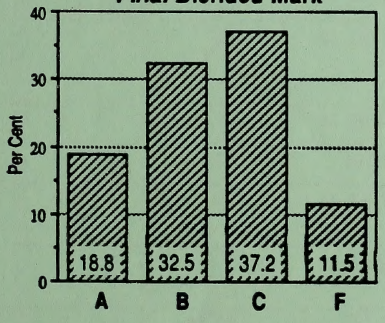

The summary information in this report provides teachers, school administrators, students, and the general public with an overview of results from the January 1992 administration of the Biology 30 Diploma Examination. The information is most helpful when used in conjunction with the detailed school and jurisdiction reports that have been mailed to schools and school jurisdiction offices. An annual provincial report containing a detailed analysis of the combined January, June, and August results will be available next fall.

Description of the Examination

The Biology 30 Diploma Examination consists of two parts: a multiple-choice section of 70 questions worth 70% and a written-response section of five questions worth 30% of the total examination mark. Question 19 in the multiple-choice section was deleted, thus reducing the multiple-choice portion of the examination to 69 questions, still retaining its worth of 70%.

Achievement of Standards

The information reported is based on the final blended marks achieved by 9 228 students who wrote the January 1992 examination. This represents an increase of about 600 students compared with the number who wrote the January 1991 Diploma Examination.

- 88.5% of these students achieved the acceptable standard (a final blended mark of 50% or higher).
- 18.8% of these students achieved the standard of excellence (a final blended mark of 80% or higher).

Generally, student achievement in Biology 30 for the first semester of 1991-92 was similar to that for the first semester of 1990-91. There was, however, a small increase (86.9 to 88.5) in the percentage of students who achieved the acceptable standard. Most students demonstrated a good understanding of the nature of scientific inquiry as it relates to the study of human physiology.

Provincial Averages

- The average school-awarded mark was 66.7%.
- The average diploma examination mark was 63.1%.
- The average final blended mark, representing an equal weighting of the school-awarded and diploma examination marks, was 65.3%.

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Results and Examiners' Comments

The examination has a balance of question types and difficulties. It is designed so that students capable of achieving the acceptable standard would obtain a mark of 50% or higher and students capable of achieving the standard of excellence would obtain a mark of 80% or higher. This examination differs in structure from the 1991 Biology 30 examinations in that it contains five written-response questions, not seven, for a total of 30 marks. The maximum value of any one written-response question is 10 marks compared with the maximum value of 6 marks on previous Biology 30 examinations. The change in structure did not have a significant effect on general student performance.

Approximately 14.7% of the students who wrote the Biology 30 Diploma Examination in January 1992 and received a blended mark had written at least one other Biology 30 Diploma Examination during the August 1990 to August 1991 period. This subpopulation (1 355) achieved an examination average of 60.4% compared to 63.6% for the population (7 873) whose first writing of a Biology 30 examination was in January 1992. By rewriting, however, this group of students (1 355) increased their examination average score from 48.2% to 60.4%.

Subtest

When analysing any detailed examination results, please bear in mind that subtest results cannot be directly compared.

Results are in average raw scores.

Machine scored: 46.8 out of 69

Written response: 15.4 out of 30

- **Course Content**
  - -Cellular Processes: 6.1 out of 9
  - -Homeostatic Mechanisms: 3.0 out of 4
  - -Nutrition and Digestion: 6.9 out of 16
  - -Body Fluids: 9.8 out of 14
  - -Breathing, Gas Exchange, and Transport: 4.7 out of 7
  - -Energy Release: 3.4 out of 5
  - -The Kidney: 6.0 out of 10
  - -Regulation of the Internal Environment: 13.1 out of 20
  - -Voluntary Movement and Body Support: 2.8 out of 4
  - -Human Reproduction: 6.5 out of 10
- **Process Skills:** 14.7 out of 26
  - -Multiple-choice questions 4, 5, 6, 9, 12, 13, 32, 38, 46, and 69; and written-response questions 1 and 2
- **Cognitive Levels**
  - -Knowledge: 17.8 out of 25
  - -Comprehension and Application: 29.6 out of 49
  - -Higher Mental Activities: 14.8 out of 25

Examination Blueprint

Each question on the examination is classified in two ways: according to the curricular content area being tested and according to the cognitive level demanded by the question. The examination blueprint illustrates the distribution of questions in January 1992 according to these classifications. Numbers with brackets [ ] indicate written-response questions and those without brackets indicate multiple-choice questions.

	Questions by Cognitive Level			
Reporting Category	**Knowledge**	**Comprehension and Application**	**Higher Mental Activities**	**Examination Emphasis (%)**
Cellular Processes	1, 2	3, 4, 5, 6, 7, 8	9	9
Homeostatic Mechanisms	11	10	12, 13	4
Nutrition and Digestion	14, 15, 16, 17	[2]	[3]	16
Body Fluids	18, 25, 29, 30	19*, 20, 21, 22, 23, 26, 27, 28, 31, 32	24	15
Breathing, Gas Exchange, and Transport	33, 34	36, 37, 38, 39	35	7
Energy Release	40	41, 42, 43, 44		5
The Kidney	47, 48	45, 46 [4]	49, 50	10
Regulation of the Internal Environment	52, 53, 55, 56, 59, 60	51, 54, 57, 58 [1]**	[1]	20
Voluntary Movement and Body Support	64	61, 62, 63		4
Human Reproduction	66, 68	65, 67 [5]	69, 70	10
Examination Emphasis (%)	25	55	20	100

* Multiple-choice question 19 was deleted.

** Written-response question 1 was reported in the subtext under Higher Mental Activites.

Multiple Choice

Question	Key	Difficulty*
1	C	77.1
2	A	81.3
3	D	72.5
4	A	54.2
5	D	70.6
6	B	51.6
7	B	69.7
8	C	88.1
9	A	44.0
10	C	79.6
11	D	82.0
12	A	70.1
13	D	63.0
14	D	75.7
15	B	85.1
16	A	51.0
17	C	49.9
18	A	72.6
19	deleted	
20	B	72.0
21	A	87.1
22	D	62.8
23	D	53.8
24	C	60.6
25	A	84.0
26	C	82.4
27	D	72.6
28	B	66.3
29	B	74.2
30	D	71.2
31	B	50.7
32	A	67.8
33	A	83.3
34	B	81.9
35	C	80.4
36	B	43.3
37	C	64.0
38	D	69.1
39	C	52.1
40	A	83.5
41	D	64.1
42	B	63.3
43	C	57.5
44	A	69.5
45	D	78.4
46	D	69.2
47	B	71.8
48	B	53.6
49	A	70.7
50	C	72.0
51	C	54.8
52	B	87.4
53	A	69.4
54	C	56.8
55	B	71.4
56	C	72.0
57	B	65.3
58	D	64.5
59	B	62.8
60	D	53.1
61	D	63.5
62	A	84.8
63	A	71.2
64	C	60.2
65	B	62.5
66	C	63.9
67	D	68.1
68	D	60.0
69	C	74.4
70	A	42.4

* Difficulty—percentage of students answering the question correctly

Multiple Choice

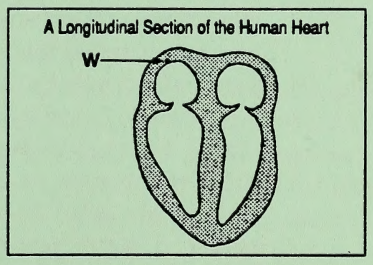
For a complete breakdown of student responses by alterative for the multiple-choice questions, please refer to the school and jurisdiction reports.

Most students who achieved the acceptable standard demonstrated an understanding of biological concepts by tracing the pathways of fluids through the human body (questions 18, 20, 30, and 45) and by identifying physiological cause-and-effect sequences (questions 37 and 58). These students also related human physiology to common everyday experiences (questions 26, 28, 44, and 52). They translated symbolic representations of biological functions into word descriptions or explanations (questions 8 and 35). They interpreted data presented in graphs (questions 12, 38, 46, and 69). When given descriptions of simple laboratory investigations, they made correct predictions (questions 4 and 5), and they evaluated experimental designs (questions 13 and 32).

Students who achieved the standard of excellence, in addition to fulfilling the expectations identified above, demonstrated the ability to integrate concepts of biology and chemistry in the context of human physiology (questions 16, 17, 36, 43, and 48). They interpreted complex sets of data (questions 6 and 9), and solved multistep problems (questions 23 and 31). They analysed complex regulatory mechanisms (questions 51, 54, and 70). They responded correctly to questions that required detailed knowledge of human tissues and organs (questions 39, 59, and 60).

Detailed comments on four questions follow.

Use the following diagram to answer question 19.



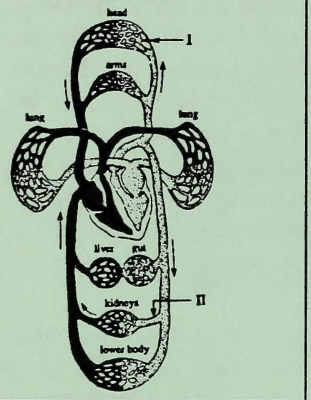
19. The heart rate will accelerate if the regulatory structure located at W is stimulated by neurotransmitters released from

- **A.** sympathetic neurons originating in the spinal cord
- **B.** sympathetic neurons originating in the hypothalamus
- **C.** parasympathetic neurons originating in the cerebrum
- **D.** parasympathetic neurons originating in the medulla oblongata

Question 19 was deleted from the examination because it contained two possible answers. The use of the word *neurons* instead of *nerves* in alternatives A and B made alternative B a correct answer in addition to alternative A, which was the keyed response.

Use the following diagram to answer questions 21 and 22.

A Schematic Representation of the Human Circulatory System



22. A partial blockage in the blood vessel labelled II could result in

A. sugar levels in the urine being higher than normal
B. reduced use of absorbed nutrients by all body cells
C. protein levels in the urine being higher than normal
• D. a higher concentration of nitrogenous compounds in the blood

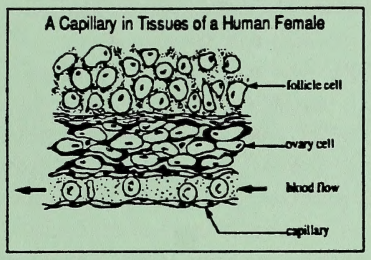
Question 22 required students to understand the basic composition of human blood and how this composition may be affected by the organ systems through which the blood flows. They then had to link the reduction of blood flow, as indicated by vessel blockage, with the role of the kidneys and possible subsequent changes in blood or urine composition. The meanings of *concentration* and *nitrogenous* were integral to identifying the correct response. This concept-integrated question was answered correctly by 90.8% of the students who achieved the standard of excellence (A) on the examination. Of the students who failed to achieve the acceptable standard, 34.0% selected the correct response and 46.5% selected either distractor A or distractor C. Many students did not understand that a reduction in blood volume, and therefore in blood pressure, would cause a decrease in the amount of urine as well as an increase in the amount of its solutes in the urine. Furthermore, these students did not understand that normal urine lacks sugar and large proteins. Of the students who obtained a B or C level of achievement, 64.6% selected the correct answer.

47. Two hormones that regulate blood levels of H_2O, Na^+, and K^+ by acting on kidney tubules are

A. ADH and adrenaline
• B. ADH and aldosterone
C. adrenaline and thyroxine
D. thyroxine and aldosterone

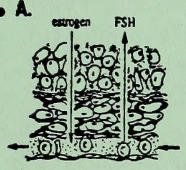
Question 47 required students to recall the names of two hormones that regulate reabsorption in the kidney. The question was worded so that the emphasis lay on the concentration of blood components rather than on urine composition. This question was answered correctly by 71.8% of the students. Students selected distractors A, C, and D, adrenaline and/or thyroxine, almost equally. Of the students who achieved the standard of excellence on the examination, 96.8% chose the correct answer. Of the students who failed the examination, only 40.4% chose the correct answer. With sufficient review, most students who enrol in Biology 30 can remember the names of the main hormones that are identified in the core curriculum and can associate these hormones with the organ functions that they regulate.

Use the following diagram to answer question 70.

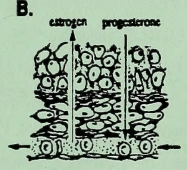


70. Which diagram represents the net movement of hormones to and from a capillary in an ovary?

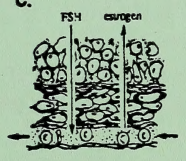
• A.



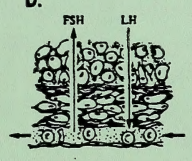
B.



C.



D.

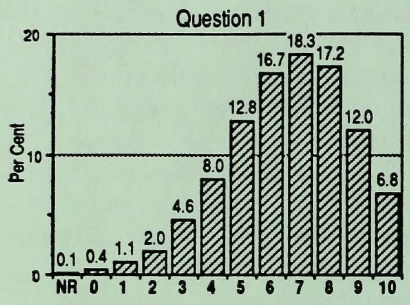


Question 70 also required students to identify a correct pair of hormones but in a more challenging context. After selecting the correct pair of hormones, students had to decide which member of the pair stimulated the ovary to produce the other hormone. Students then had to determine the proper sequence of stimulus and response by analysing the direction of the hormone arrows in relation to the direction of blood flow through the ovary. Only 42.4% of the total population selected the correct response. Of the students who achieved the standard of excellence on the examination, 80.0% chose the correct response. Of the students who achieved the acceptable standard (those receiving a letter grade B or C on the examination), 39.0% selected the correct response. An additional 21.0% of this group selected the correct pair of hormones but in the wrong relationship (alternative C). The remaining 40% of this group chose incorrect pairs of homones (alternatives B and D). Of the students who obtained an F on the examination, only 18.5% analysed the diagrams correctly and selected the correct pair of hormones. This question very clearly identified the various levels of student achievement.

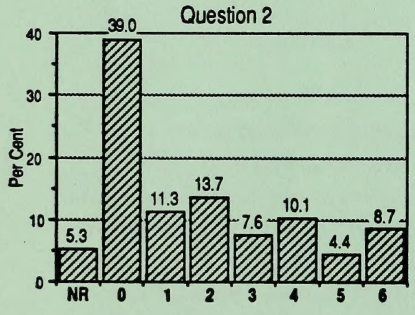
Written Response

The five questions in the written-response section are designed to assess achievement on six of the 10 content strands for Biology 30. In addition, question 1 required students to analyse and evaluate experimental designs and scientific data. To answer this question, students were expected to draw on their understanding of scientific process skills. All five questions required students to go beyond the recall of information and to apply their understanding of biological concepts to problems in human physiology. The questions required students to analyse contexual material before composing responses. Question 3 in particular required students to integrate several concepts and to compose a response that clearly linked the structural and functional characteristics of specialized body parts.

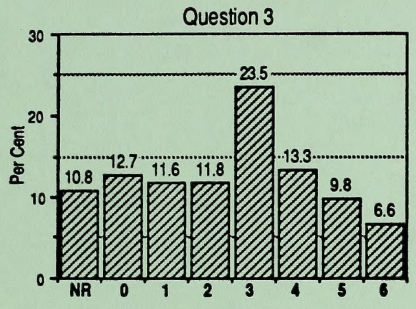
Responses to the written-response section indicated that most students approached the examination with serious intent and expended commendable effort. Some students achieved full marks on each of the five questions. However, approximately 47.5% of the students obtained less than 15 marks out of 30 on the written-response section of the examination. Many students did not present clear and specific answers, but rather communicated in vague generalities, leaving too much interpretation up to the examiner.



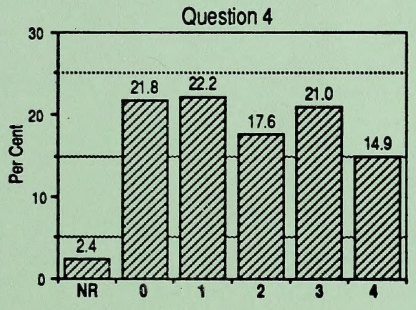
Question 1: Most students demonstrated a good understanding of the nature of scientific investigation. They were able to analyse and evaluate experimental designs with a fair degree of sophistication. The students (6.8%) who achieved full marks on this question composed clear and concise answers. They showed an excellent understanding of scientific investigative processes. Most students recognized the problem (part a) that was investigated, but some did not express it in a way that clearly identified the two variables involved. Part b was well answered by most students. Surprisingly, many students had difficulty with part c. Either they did not identify a specific structure, or their explanation of the effect of caffeine on the endurance of a specific body structure was imprecise or missing. In part d, most students were able to identify difficulties in the two experimental designs, but many failed to explain how these difficulties could cause problems in obtaining valid results. Most students understood that the experimental subject's knowledge of the treatment can affect the results (part e). The most common problem in part f was the failure of students to formulate and then support a conclusion using both studies. Sometimes it was difficult for the examiner to determine if a student was just careless or did not understand the importance of considering all the data, even if they were inconsistent. Only 16.2% of the population failed to achieve the acceptable standard on this data-based research question, and 36% achieved the standard of excellence. On this 10-mark question, the average mark was 6.57 or 66% of the available mark.



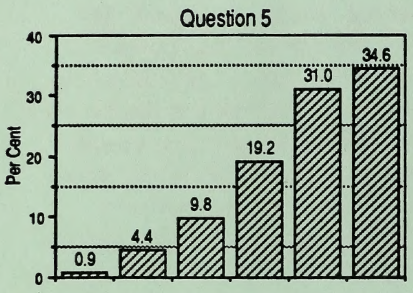
Question 2: Students were required to link their understanding of enzyme function, acids and bases (pH), chemical digestion of protein, and hormone regulation. The expectations embodied in this question are firmly anchored in the Biology 30 *Course of Studies* as well as in diploma evaluation tradition. It is therefore suprising that 69.3% of the students did not achieve the acceptable standard on this question. Many students made correct predictions but then failed to support them with adequate explanations. Very few students made a distinction between pepsinogen and pepsin. The concept of active versus inactive enzymes was not clearly linked to variations in pH. Inappropriate terminology was used (dissolving or frying instead of digestion). In part b, the names of enzymes, acids, or bases were used in the place of hormones. Many students did not match the region with the proper hormone and/or function. The students who achieved the standard of excellence on the examination obtained an average of 74% on this question in contrast to an average of 4% for those who failed the examination. On this 6-mark question, the average mark was 1.76 or 29% of the available mark.



Question 3: Approximately 16% of the students gave excellent answers to this partially open-ended question, but almost 24% obtained no marks at all. Many students identified appropriate structures but then presented vague supportive explanations. In particular, the links between the nervous system and the digestive system were weak. Many students said that the nervous system has the ability to control the amounts and/or types of nutrients that are absorbed by the small intestine. Students confused *enzymes* with *hormones* and *absorb* with *reabsorb*. Some students described the interrelationships between the circulatory and digestive systems in general and did not take into account the limits set by the context of the question. Many students demonstrated poor organizational skills. These students could have benefited from preparing a rough draft on the tear-out pages provided. On this 6-mark question, the average mark was 2.47 or 41% of the available mark.



Question 4: Most students accounted for the absence of glucose by stating that it was reabsorbed. Some students expanded on their initial idea but in so doing introduced elements of error, e.g., glucose is reabsorbed in the loop of Henle. In part b, most students identified a substance found in the fluid of Q but not in the fluid of R. Many did not obtain a second mark for part b because they did not present a satisfactory explanation. The concept of separation by size was often omitted. The answers to part c tended to be very general and did not identify the specific effect of ADH on the target site (membrane of the distal tubule). Many students focused on the process of reabsorption of water rather than on the change in permeability of the membrane. From the responses, it appears that the concept of target site was not adequately understood. A number of students did state that ADH affects the permeability of structure T but then failed to say whether ADH increased or decreased the permeability of structure T to water. Fifty-six per cent of the students who obtained a letter grade of B or C on the examination obtained 2 marks or more on this question, compared with 11% of the group who failed the examination. On this 4-mark question, the average mark was 1.80 or 45% of the available mark.



Question 5: Most students understood the general function of each of the structures affected by a special condition. Therefore, it was not difficult for them to identify how each condition could prevent fertilization. Students lost marks because they neglected to finish their explanations, used specialized vocabulary incorrectly (semen instead of sperm), or interchanged male with female structures (seminiferous tubules with fallopian tubes). Of the students who achieved the standard of excellence on the examination, 67.5% explained correctly how all four of the conditions could cause sterility. Of the students who failed the examination, 7.8% explained all four conditions correctly. On this 4-mark question, the average mark was 2.80 or 70% of the available mark.

For further information, contact Lowell Hackman or Phill Campbell at the Student Evaluation Branch, 427-2948.